California High Speed Rail Authority

Bees and Pollination

"Will the wind produced by the high-speed train disrupt bee pollination activity?"

Agricultural Working Group White Paper

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BACKGROUND

The California High Speed Rail Authority (CHSRA) proposes to establish a new railway in the San Joaquin Valley. The new rail alignment is proposed to be constructed either on existing farmland or adjacent to, where such land lies between urban and commercial parcels in the Valley. Most, if not all, of the Valley counties through which the railway is proposed to travel have Right-To-Farm Ordinances which make reference to "customary and/or traditional" agricultural practices. The proposed project has raised questions and concerns regarding its impact on many established and customary agricultural practices and consequent potential imposition of new regulatory restrictions. Customary agricultural practices found in the Valley are as varied as is the diversity of agricultural products and commodities produced. The San Joaquin Valley as a natural resource is unique to the state, the nation, and arguably the world by the quality and quantity in the diversity of its agriculture.

The CHSRA has created a "technical" agricultural working group to assist the CHSRA in responding to the more technically oriented questions/concerns that have been asked regarding impacts to agriculture resulting from activities during the construction phase and the daily operation of the High Speed Train. The agricultural working group membership is comprised of members in possession of technical expertise in various categories of agriculture activities and infrastructure. In regards to this paper's topic of *bees and pollination,* the University of California experts possess incumbent knowledge and expertise on this subject.

ISSUE

Concern has been expressed by the agricultural community in regard to the wind that may be created from the high-speed train that would result in disruption of bee pollination activity.

DISCUSSION

Bees and Pollination

Pollination is necessary for production of about one-third of the crops we produce in this country. There are many types of pollinators that contribute to fruit, vegetable, nut, and seed production. The most common are the insect pollinators including a large number of bee species. Honey bees are the most recognized pollinator and are valued because of the wide variety of crops they pollinate and the ability to move large populations of pollinating insects to locations where they are needed. Honey bees can forage as far away as 3-5 miles from their colony although most foragers tend to stay within a few hundred yards of the colony if it is in or adjacent to a crop with adequate food rewards (nectar and pollen). Other common commercial pollinators are the alfalfa leafcutting bee (*Megachile rotundata*), alkali bees (*Nomia melanderi*), and the Blue Orchard Bee (*Osmia lignaria*). There are also many native bees that pollinate flowering plants in the landscape.

Effects of wind on pollinator activity

Honey bees forage when temperatures are 55°F and higher; they do not forage in rain or in wind stronger than 12 mph. Cloudiness also reduces flight activity, especially near threshold temperatures. A honey bee normally flies at a speed of 18 mph empty and 15 mph carrying a load (e.g. pollen, nectar, or

water). However, when agitated and empty, honey bees can fly 20-21 mph. They cannot carry a load upwind against much more than a 15 mph wind.

As wind speed increases, the number of foragers declines in a linear relationship and foraging behavior may change. In some publications, researchers report that when wind speeds reach 15-20 mph, most bees will stop visiting blossoms in the trees and will work blossoms on the orchard floor instead. This, however, is habitat dependent according to Dr. Eric Mussen, UC Davis Apiculturist. If the ground cover is really lush, the bees may be observed flying around in it, but it would have to be close to the hives. Given the foraging characteristics of individual bees, the same bees do not forage in trees today and on ground cover the next day. It is more likely that ground cover bees fly both days and tree bees only in lighter winds.

We also recognize that bees drift more under windy conditions, even if the winds are moderate. A heavily-laden bee may not make the effort to fly against the wind to return to its hive, entering a closer hive instead. A strong prevailing wind may force foraging bees down to the end of a row of hives in an apiary or to downwind apiaries in a field or orchard setting. Beekeepers sometimes exchange upwind hives with the downwind hives to equalize the populations during the pollination season.

Almond Pollination

Currently, the majority of commercial almond varieties in California require cross-pollination with another compatible variety. Almond flowers are cross-pollinated by insects, mainly honey bees, with very little if any cross-pollination accomplished by wind. As almonds move to self-compatible varieties, wind will most likely improve sets, particularly if it is gusty enough to cause the petals to “flap” and push the pollen-bearing anther sacs against the stigma. Since self-pollen can synergize growth of cross-pollen in cross-pollinated varieties, wind could also be an advantage, but winds this strong usually deter bee flight.

Climatic conditions affect pollination, with the major effect being on the activity of honey bees. Strong winds may injure flowers and cause loss of pollen. High temperatures, wind, and low humidity may cause desiccation of the style and reduce the receptive period of the blossom for pollination. If the style dries too quickly (before the pollen tubes have a chance to grow down to the ovary) fertilization can be affected, even if pollination has occurred. For fruit with more delicate flowers, such as prunes, a few days of dry winds can destroy crop potential. Winds reduce cross-pollination in prunes, and in some cases apricot, when the desiccated pollen clumps on the dehisced anthers make it more difficult for bees to collect. This has not been observed in almond or peach.

Although honey bees are currently the only pollinators available in adequate numbers to service the almond acreage in California, there are efforts underway to commercialize the Blue Orchard Bee (aka Orchard Mason Bee) (*Osmia lignaria*) for almond pollination.

CONCLUSION

Depending on their strength, wind gusts may blow pollinators off blossoms if the crops are planted right near the tracks, but they most likely would right themselves and return to the blossom. Some pollinators are going to be killed upon impact with the trains, but this is no different from what they experience with more slowly moving cars, trucks, busses, etc. Beekeepers may need to consider different hive placement to avoid impacts should fast moving trains produce winds above the thresholds discussed. Furthermore, consideration may be given to planting or erecting barriers (e.g. a fence or wall) to force the bees to fly up and over the trains to lessen any possible impact.

Sources of Information

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Eric Mussen, Tom Gradziel, and Joe Connell – personal communication.
Eric Mussen cited page 412 of the text book “The Illustrated Encyclopedia of Beekeeping” by Morse and Hooper for the wind speed at which bee flight is stopped.